YARN CORE

FIELD OF THE INVENTION

The invention relates to yarn cores on which yarn is wound during manufacture, and more particularly relates to yarn cores having a start-up groove for catching and clamping the yarn to start the winding process.

BACKGROUND OF THE INVENTION

Yarn cores are employed in the textile industry for winding and supporting yarn packages. In the package forming process, a moving yarn line is strung up onto a rapidly rotating empty core. In the manual string-up process, the moving yarn line is usually held by an aspirator gun and the yarn line brought into tangential contact with the rotating empty core. Typically, a start-up groove is provided in the surface of the core, normally adjacent to one end of the core. The yarn line is manually directed by movement of the aspirator gun into the groove, which grips the yarn line thereby initiating the wind-up process. Both co-current and counter-current string-up processes are used in the textile industry. In the co-current process, the yarn is moving in the same direction as the core rotation as the yarn is led into engagement with the core for catching in the start-up groove. In the counter-current process, the yarn is moving in the opposite direction to the core rotation.

Newer winder technologies provide for the string-up process to be automatically initiated without manual intervention. For example with turret-type winders, an empty yarn core is moved from a waiting position to a winding position when a fully wound yarn package is formed on another position on the apparatus. The empty core is rotated rapidly and moved into tangential contact with the thread line being wound on the other, now full yarn package. This initiates string-up for the empty core and terminates winding for the fully wound core. For this automated process to work effectively, the start-up groove on the empty core must readily and reliably catch the incoming yarn line without operator intervention.

Multiple-width start-up grooves in yarn cores have been provided in an effort to improve the yarn pick up propensities of the yarn groove. In the multiple-width start-up grooves, one lengthwise portion of the groove is relatively wide while an adjacent lengthwise portion is relatively narrow. The core is rotated so that the wide portion of the groove forms the leading portion; the narrow portion of the groove forms the trailing portion. The transition portion of the groove forms a "nip" for gripping and catching the yarn.

In the textile industry, yarn manufacturing and wind-up speeds have continually increased. Moreover, in many cases, yarn properties including yarn strengths have increased. As yarn manufacturing speeds have increased, the need for improved gripping action by the start-up groove in the textile cores has also increased. Moreover, in the case of automated string-up winders, the gripping action of the start-up groove must be extremely reliable so that the yarn line can be readily gripped and severed without operator intervention. However, it has been found that conventionally formed start-up grooves in textile yarn cores do not always reliably and repeatably perform these functions, particularly when used with different sized yarns, with yarns of different strengths, and/or with automated winding devices operating at high speeds. When a string-up operation fails because the start-up groove fails to properly catch and grip the yarn, the failure represents a significant disruption to the winding process and substantial downtime can result.

SUMMARY OF THE INVENTION

The present invention addresses the above needs and achieves other advantages by providing a yarn core having a start-up groove in which a specially configured yarn latch is formed for snagging the yarn so that the yarn is much less likely to skip back out of the groove, thereby significantly improving the string-up efficiency of the core. Yarn cores in accordance with the invention have achieved string-up efficiencies (percentage of attempted string-ups that are successful) of 99 percent or better.

In accordance with one embodiment of the invention, a yarn core comprises a tubular core having an outboard end and an inboard end. A yarn start-up groove is formed in the outer surface of the core wall proximate the outboard end thereof. The start-up groove comprises a generally V-shaped groove formed in the outer surface of the core wall partway through the thickness thereof, the groove having opposing inboard and outboard walls wherein the inboard wall faces generally toward the outboard end of the core. The groove comprises a relatively wide V-shaped lead-in groove that leads to a relatively narrow V-shaped clamping groove, with a V-shaped transition groove extending between the trailing end of the lead-in groove and the leading end of the clamping groove. A yarn latch is located in the transition groove, the yarn latch comprising a tapering protrusion projecting from the inboard wall of the groove generally in the rotation direction of the core wall and extending toward the outboard wall of the groove partway across a width defined between the inboard and outboard walls. The yarn latch serves to snag a yarn led into the lead-in groove.

In a preferred embodiment of the invention, the inboard and outboard walls of the lead-in and transition grooves are depressed below the outer surface of the core wall while the yarn latch is substantially undepressed below the outer surface. The latch thus stands out to more-readily snag the yarn.

Advantageously, the lead-in groove in cross-section defines a radially outer portion having the inboard and outboard walls sloped relatively shallowly toward each other, and a radially inner portion having the inboard and outboard walls sloped relatively steeply toward each other and coming together at a bottom of the lead-in groove. The transition groove advantageously has a similar configuration.

In a preferred embodiment, the yarn start-up groove extends about more than half the circumference of the core. The lead-in groove extends about at least one-quarter of the circumference of the core. Preferably, the lead-in groove has a constant width except for a tapered portion at the leading end of the lead-in groove. The clamping groove has a constant width along substantially the entire length thereof.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING(S)

Having thus described the invention in general terms, reference will now be made to the accompanying drawings, which are not necessarily drawn to scale, and wherein:

FIG. 1 is a fragmentary perspective view of an outboard end portion of a yarn core in accordance with one embodiment of the invention;

FIG. 2 a fragmentary front elevation of the outboard end portion of the yarn core of FIG. 1;

FIG. 3 is magnified elevation of the transition portion and yarn latch of the yarn core;

FIG. 4 is a cross-sectional view taken on line 4-4 of FIG. 2 through the lead-in portion of the start-up groove of the yarn core;

FIG. 5 is a cross-sectional view taken on line 5-5 of FIG. 2 through the transition portion of the start-up groove of the yarn core, showing the yarn latch in further detail;

FIG. 6 is a cross-sectional view taken on line 6-6 of FIG. 2 through the clamping portion of the start-up groove of the yarn core;

FIG. 7A depicts a beginning of a string-up process with a yarn core in accordance with one embodiment of the invention, showing a yarn being led into the start-up groove;

FIG. 7B depicts the string-up process at a slightly later instant in time, showing the yarn being engaged by the yarn latch; and

FIG. 7C depicts the string-up process at a still later instant in time at which the yarn has been successfully snagged by the yarn latch and has been severed from the trailing end.

DETAILED DESCRIPTION OF THE INVENTION

The present inventions now will be described more fully hereinafter with reference to the accompanying drawings, in which some but not all embodiments of the invention are shown. Indeed, these inventions may be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will satisfy applicable legal requirements. Like numbers refer to like elements throughout.

FIGS. 1, 2 and 3 illustrate a preferred textile core **10** according to the invention which includes a multiple width start-up groove **12**. The core **10** is a tubular body formed from paperboard, e.g., spirally wound paperboard, plastic, or the like. Although illustrated as having a cylindrical shape, it will be apparent that the tubular body could also have a frustroconical or other shape. Typically a cylindrical textile core will have an outside diameter of from about two inches up to about seven inches, and a wall thickness of from about one-sixth inch up to about one-half inch.

The multiple width start-up groove **12** in core **10** includes a wide lead-in portion **14**, a transition portion **15**, and a narrower trailing end or clamping portion **16**. As illustrated in FIGS. 7A-7C, further described below, a moving yarn line **18** is contacted first with the lead-in portion **14** of groove **12** and thereafter encounters the transition portion **15** and then the narrower trailing end portion **16** of groove **12**. As the yarn line **18** encounters the narrower portion of the groove the yarn line is gripped by the groove and severed for initiation of winding of the yarn line **18** onto the core **10**. As further described below, the start-up groove **12** includes a yarn latch to assist in snagging the yarn and preventing the yarn from skipping back out of the start-up groove.

The groove **12** in the illustrated embodiment extends around more that half the circumference of the tube **10**, for example, about 235 degrees. In the illustrated embodiment, the lead-in portion **14** of the groove constitutes somewhat less than half (e.g., about 90 degrees) of the total circumferential extent of the groove while the clamping portion **16** of the groove constitutes somewhat more than half (e.g., about 135

degrees) of the circumferential extent of the groove; alternatively, the lead-in and clamping portions can be of about equal length, or the lead-in portion's length could exceed that of the clamping portion. It will also be apparent to the skilled artisan that the total length of the groove **12** can be greater or less than half the circumference of the tube **10**. Generally, it is preferred that the groove not extend around the full periphery of the tube so that the strength of the tube is not weakened. However, the length of the groove can readily be extended if desired. In addition, two wider, lead-in groove portions **14** can be provided, one on each end of the narrower portion **16** of the groove as explained in greater detail in U.S. Pat. No. 4,369,933 to Bedenbaugh and U.S. Pat. No. 4,371,130 to Case, which patents are incorporated herein by reference.

FIGS. 4 and 6 illustrate, respectively, the cross-sections of the wider, lead-in portion **14** of the groove and the narrower trailing end portion **16** of the groove. In cross section, the wide lead-in portion **14** of the groove is generally V-shaped and has two sidewalls disposed on opposite sides of a center line **22** which extends radially into the tubular body **10**. Each of the sidewalls are compound sidewalls having a first surface **24** extending upwardly from the bottom **26** of the groove and forming an acute angle α_1 with the center line. A second surface **32** of each compound sidewall extends downwardly from the top of the groove **14** and defines a second predetermined acute angle α_2 with axis **22** of groove **14**.

Advantageously, the angle α_1 formed between the bottom portion **24** of the compound sidewall and the center line **22** of the groove can range from less than about 5° up to about 15°, preferably 5° to 10°, while the angle α_2 formed between the upper portion of the sidewall **32** and the center line **22** can range from less than about 15° up to about 45°, preferably from about 25° to about 35°. These ranges are preferred when both sidewalls of the groove **14** are angled with respect to the center line **22**. In some cases, one sidewall may be essentially vertical and only the other of the sidewalls will be an angled wall. In the event that only one of the sidewalls is an angled, compound sidewall, then the angles formed by the bottom wall portion and the top wall portion with the center line will typically be greater than described above.

The compound angle groove illustrated in FIG. 4 is believed to readily accommodate yarns having any of various counts or deniers, ranging on the denier scale, for example, from 30 denier or less up to 2,000 denier or greater. In this regard, the wider portion of the groove at the top thereof is able to receive and grip larger yarns while the narrower portion of the groove at the bottom thereof is capable of receiving and gripping smaller size yarns.

The cross-section of the narrower clamping portion **16** of the groove **12** is seen in FIG. 6. Advantageously, this groove portion includes two simple or straight angled walls **40**, each of which forms an acute angle α_3 with center line **22** of the groove **16**. Typically, when there are two angled sidewalls as illustrated in FIG. 5, the angle α_3 formed by each sidewall and the center line **22** will range from less than about 5°, up to about 20°, preferably from about 5° to about 10°. If only one sidewall is angled, then the angle formed by the sidewall and the center line of the groove will range from about 10° up to about 45°, preferably from about 10° to about 20°.

FIGS. 3 and 5 depict the transition portion **15** of the groove. The transition portion has an outboard wall (i.e., the wall closer to the outboard end of the tube) that is a compound angled wall similar to the walls of the wide lead-in portion **14** of the groove. Thus, the outboard wall has a lower sidewall **42** forming a relatively small acute angle with the center line **22** of the groove; this angle can be in the same range as that given for α_1 above. The outboard wall has an upper sidewall **44** forming a relatively larger acute angle with the center line; this angle can be in the same range as that given for α_2 above. The sidewalls **42** and **44** thus can be regarded as extensions of the sidewalls **24** and **32** of the wide portion **14** of the groove. The inboard wall of the transition portion **15** has a lower sidewall **46** that forms a relatively small acute angle with the center line **22**, similar to the angle of the outboard lower sidewall **42**. An upper sidewall **48** of the inboard wall forms an acute angle with the center line essentially the same as the angle of the lower sidewall **46**; thus, the lower sidewall **46** and upper sidewall **48** together constitute a wall that extends from the bottom of the groove upward to the cylindrical outer surface of the core **10** at an essentially constant acute angle relative to the center line. The inboard wall of the transition portion **15** also defines a yarn latch **50** (best seen in FIG. 3) to assist in

snagging a yarn **18**. The yarn latch **50** comprises a generally triangular-shaped finger of material that projects from the inboard wall of the groove toward the outboard wall of the groove; the sharp vertex of the latch points generally in the rotation direction of the yarn core. The yarn latch is formed by two walls, one of which is the upper sidewall **48** described above; the other wall **52** (FIG. 3) extends from the vertex of the latch in a direction (generally opposite to the rotation direction) that is angled with respect to the circumferential direction and joins the upper sidewall **32** of the inboard wall of the groove. Accordingly, there is a space **54** defined between the wall **52** and the wall **32**. The top surface of the yarn latch is level with the cylindrical outer surface of the yarn core, whereas the wall **32** is depressed below the cylindrical outer surface. Consequently, the space **54** narrows in the direction opposite to the rotation direction of the yarn core and also narrows in the depth direction of the groove. The yarn **18** is snagged by the yarn latch **50** during a string-up operation by wedging in the narrowing space **54**.

FIG. 7A through 7C depict a yarn string-up operation using the yarn core **10**. The start of the string-up operation is shown in FIG. 7A. A yarn **18** is directed from a texturizer or other processing device by means of a vacuum aspirator (not shown) and is lead by a mechanical hook (not shown) or the like into the groove **12** of the rapidly rotating yarn core; the yarn travels in a direction opposite to the rotation of the core. The yarn drops into the wide lead-in portion **14** of the groove and is in turn led into the transition portion **15** and narrow clamping portion **16** of the groove. As the core continues to rotate, as shown in FIG. 7B, the yarn wedges in the space between the yarn latch **50** and the inboard wall of the groove and becomes trapped by the latch. With still further rotation of the core, as shown in FIG. 7C, the yarn begins to wind around the core and is thereby pulled back from the vacuum aspirator and drawn over a cutting blade (not shown) or the like so as to sever the leading portion of the yarn to create a tail end **18'**; the yarn coming from the texturizer is then wound about the yarn core.

The design of the yarn start-up groove **12** with the yarn latch **50** in accordance with the invention has been found to significantly improve string-up efficiency relative to yarn cores such as described in the aforementioned U.S. Patent No. 5,211,354. Yarn

cores in accordance with the invention have achieved string-up efficiencies (percentage of attempted string-ups that are successful) of 99 percent or more.

Many modifications and other embodiments of the inventions set forth herein will come to mind to one skilled in the art to which these inventions pertain having the benefit of the teachings presented in the foregoing descriptions and the associated drawings. Therefore, it is to be understood that the inventions are not to be limited to the specific embodiments disclosed and that modifications and other embodiments are intended to be included within the scope of the appended claims. Although specific terms are employed herein, they are used in a generic and descriptive sense only and not for purposes of limitation.